BS EN 15199-4:2015

BSI Standards Publication

Petroleum products — Determination of boiling range distribution by gas chromatography method

Part 4: Light fractions of crude oil

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National foreword

This British Standard is the UK implementation of EN 15199-4:2015.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Petroleum products - Determination of boiling range distribution by gas chromatography method - Part 4: Light fractions of crude oil

Produits pétroliers - Détermination de la répartition dans l'intervalle de distillation par méthode de chromatographie en phase gazeuse - Partie 4 : Lumière fractions du pétrole brut

Mineralölerzeugnisse - Gaschromatographische Bestimmung des Siedeverlaufes - Teil 4: Leichte Fraktionen des Rohöls

This European Standard was approved by CEN on 1 August 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 15199-4:2015) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2016, and conflicting national standards shall be withdrawn at the latest by March 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 15199 consists of the following parts, under the general title *Petroleum products — Determination of boiling range distribution by gas chromatography method*:

— *Part 1: Middle distillates and lubricating base oils*

— *Part 2: Heavy distillates and residual fuels*

— *Part 3: Crude oil*

— *Part 4: Light fractions of crude oil*

This part of the standard is based on IP 601 [1] and describes the determination of boiling range distribution of hydrocarbons up to n-nonane in crude oil. The results of this test method can be combined with those from EN 15199-3, to give a full boiling point distribution of crude oil.

Part 4 is harmonized with ASTM D7900 [2].

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard describes a method for the determination of the boiling range distribution of petroleum products by capillary gas chromatography using flame ionization detection. This European Standard is applicable to stabilized crude oils and for the boiling range distribution and the recovery up to and including n-nonane. A stabilized crude oil is defined as having a Reid Vapour Pressure equivalent to or less than 82,7 kPa as determined by IP 481 [3].

NOTE For the purposes of this European Standard, the terms *"% (m/m)"* and *"% (V/V)"* are used to represent respectively the mass fraction, ω, and the volume fraction, φ.

WARNING — The use of this European Standard can involve hazardous materials, operations and equipment. This European Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to take appropriate measures to ensure safety and health of personnel prior to application of the standard, and fulfil statutory and regulatory requirements for this purpose.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 3170, *Petroleum liquids — Manual sampling (ISO 3170)*

EN ISO 3171, *Petroleum liquids — Automatic pipeline sampling (ISO 3171)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
recovery
combined mass percentages of all light hydrocarbon peaks (except the internal standard peak) in the sample up to and including *n*-nonane

4 Principle

An amount of internal standard is quantitatively added to an aliquot of the stabilized crude oil. A portion of this mixture is injected into a pre-column in series via a splitter with a capillary analytical column. When the *n*-nonane has quantitatively passed to the analytical column, the pre-column is back-flushed to vent the higher boiling components. The individual components are identified by comparison with reference chromatograms and a database of hydrocarbon compounds (see Annex A). The boiling point distribution and recovery up to and including *n*-nonane (*n*-C9) is calculated.

5 Reagents and materials

5.1 Stationary phase for columns, with a bonded polydimethylsiloxane (PDMS) stationary phase for both the pre-column and the analytical capillary column.

5.2 Compressed gases

5.2.1 Carrier gas, helium or hydrogen of at least 99,995 % *(V/V)* purity or higher is required. Any oxygen present shall be removed by a suitable chemical filter.

CAUTION — If hydrogen is used as carrier gas, follow the safety instructions from the GC instrument manufacturer.

5.2.2 Combustion gases, hydrogen and clean air for the flame ionization detector, and suitable filters shall be used to ensure adequate gas cleanliness.

5.3 Internal standard, having a baseline resolution from any adjacent eluting peaks (Hexene-1 or 3,3-dimethylbutene-1 (99 % pure) have been found to be suitable).

5.4 Valve switching mixture, a qualitative mixture of approximately 1 % (*m/m*) of each normal alkane from pentane to decane.

5.5 Carbon disulphide (CS_2), purity 99,7 % (V/V) minimum.

WARNING — Extremely flammable and toxic by inhalation.

6 Apparatus

6.1 Analytical balance

Capable of weighing with an accuracy of 0,1 mg.

6.2 Gas chromatograph

The typical operational characteristics of the gas chromatograph are described in Table 1.

Two different pre-column configurations are possible:

The first configuration (A) employs a 1-metre column contained in a temperature controlled valve box, separately controlled. The valve box in this configuration is isothermal.

The second configuration (B) is a short pre-column (a packed injection port liner), that fits into the injection port. The injection port will be temperature programmed.

6.3 Detector

Flame Ionization Detector with sufficient sensitivity to detect 1 % mass n-heptane with a peak height of at least 10 % full-scale deflection under the conditions given in the method. When operating at this sensitivity level, detector stability shall be such that a baseline drift of not more than 1 % per hour is obtained. The detector shall be connected to the column carefully to avoid any cold spots. The detector shall be capable of operating at a temperature equivalent to the maximum column temperature used.

6.4 Pre-column configurations

6.4.1 Heated valve switching box (see Figure B.1)

For the isothermal 1 metre pre-column, a heated valve box is needed with its own temperature control. The box will contain an automated six-port valve which is used to back-flush the pre-column.

The six-port valve should be made out of material which will not be corroded by the sample (Some crude oils contain high amounts of sulfur components). The valve shall be situated in a heated isothermal oven and be attached to the injector, pre-column, splitter, analytical column and the detector without any cold spots.

6.4.2 Injection port (see Figure B.2 and B.3)

A temperature programmable injection port capable of containing a 7,5 cm pre-column, and this injection port shall be equipped with a back-flush option. This injector can be connected directly to the capillary column (Figure B.2) or via a splitter (Figure B.3).

Table 1 —Typical chromatographic conditions

	Pre-column A	Pre-column B	Analytical	Accelerated Analytical
Column length – m	1,0	0,075	50 or 100	40
Column internal diameter – mm	2	2,5	0,25	0,10
Column material	polydimethylsiloxane			
Phase loading – %	5	10		
Film thickness – µm			0,5	
Injection volume – µL			0,1	0,1
Injector split ratio			100: 1	600: 1
Injector temperature – °C	300	100		
Pre-column temperature – °C	200	100		
Injector program rate – °C/min		50		
Final injector temperature – °C		300		
Initial oven temperature – °C			35	35
Hold time – min			30	2,6
Oven program rate –°C/min			2	50 → 45 °C (hold time 3 min)
				5 → 60 °C (hold time 3 min)
				9,5 → 200 °C
Final oven temperature – °C			200 (hold time 20 min)	200 (hold time 1 min)
Flame Ionization Detector – °C			300	300

6.5 Analytical column

6.5.1 General

The column elutes hydrocarbons in a boiling point order. The eluate from the injector passes through the pre-column before eluting onto the analytical column.

6.5.2 Resolution

Determine the resolution between the internal standard and the nearest n-paraffin peak as per Formula (1).

$$P = \frac{2(t_2 - t_1)}{1{,}699(w_1 + w_2)} \qquad (1)$$

Where

P is the column resolution;

t_1 is the retention time of the first peak (peak 1, see Figure 1);

t_2 is the retention time of the second peak (peak 2, see Figure 1);

w_1 is the peak width at half height of peak 1;

w_2 is the peak width at half height of peak 2.

With Hexene-1 as I.S., the resolution is determined between the I.S and n-hexane. The resolution shall be at least 2,0.

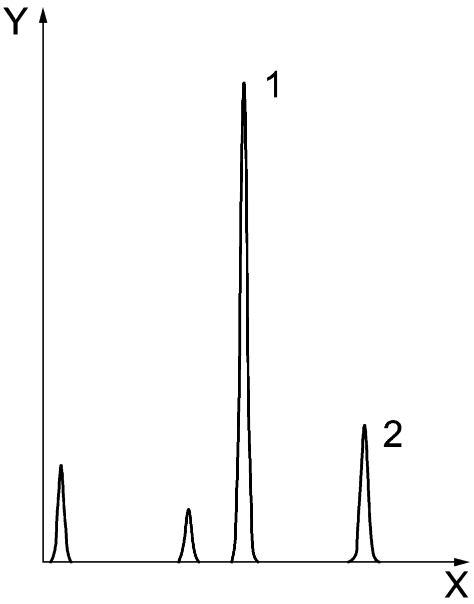


Figure 1 —Determination of resolution

6.6 Skewness

Determine the skew of the n-hexane peak by measuring the width of the leading part of the peak at 5 % peak height (A) and the width of the following part of the peak at 5 % peak height (B). The ratio (B)/(A) shall be not less than 1 or more than 4. See Figure 2 for further clarification.

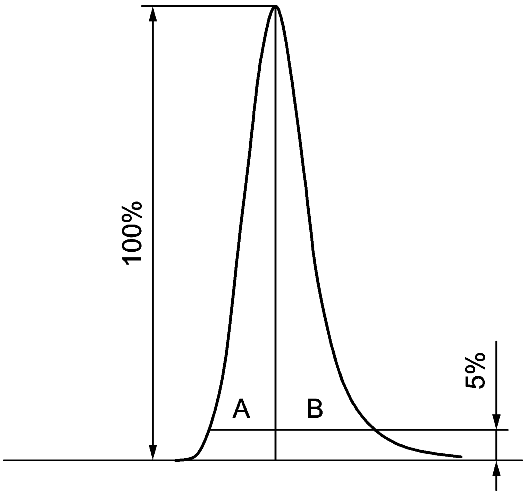


Figure 2 —Calculation of peak skewness

6.7 Data collection

A PC based chromatography data system or integrator with suitable software may be used. For systems using the analytical column, a data -sampling rate of 5 Hz is the recommended minimum.

For systems using the accelerated analytical column, a data-sampling rate of 20 Hz is required.

7 Sampling and sample handling

Take samples in accordance with either EN ISO 3170 or EN ISO 3171.

8 Calculation of response factors

Calculate the flame ionization detector response factor relative to methane, which is considered to have a response factor of unity (= 1), for each hydrocarbon group type of a particular carbon number using Formula (2).

$$RRf = \frac{\left[\left(C_{\text{aw}} \times C_n\right) + \left(H_{\text{aw}} \times H_n\right)\right] \times 0{,}748\,7}{\left(C_{\text{aw}} \times C_n\right)} \qquad (2)$$

Where

RRf is relative response factor for a hydrocarbon type group of a particular carbon number,

C_{aw} is atomic mass of carbon, 12,011,

C_n is number of carbon atoms in the hydrocarbon type group, of a particular carbon number,

H_{aw} is atomic mass of hydrogen, 1,008,

H_n is number of hydrogen atoms in the hydrocarbon type group of a particular carbon number, and 0,748 7 is factor to normalize the result to a methane response of unity (= 1).

Table 2 gives some response factors already calculated.

Table 2 — Calculated response factors for hydrocarbons

No. of Carbon atoms	Naphthenes	Paraffins	Cyclic olefins	Mono-olefins	Aromatics
3		0,916		0,874	
4		0,906		0,874	
5	0,874	0,899	0,849	0,874	
6	0,874	0,895	0,853	0,874	0,811
7	0,874	0,892	0,856	0,874	0,820
8	0,874	0,890	0,859	0,874	0,827
9	0,874	0,888	0,860	0,874	0,832

9 Procedure

9.1 Sample preparation

Weigh to the nearest 0,1 mg, approximately 5 g ± 0,2 g of sample into a tared, screw-capped vial.

Add approximately 0,15 g ± 0,02 g of internal standard and reweigh to the nearest 0,1 mg. Where the mass of available sample is less than 10 g, the internal standard shall be added to create the equivalent of a 3 % concentration.

Gently mix the two liquids without causing the sample to degas. Carbon disulphide (5.5) may be added to improve the viscosity of the sample.

Fill the sample into GC vials with a minimum amount of headspace. Store the vials in a sub ambient cupboard until use.

NOTE The amount of sample and internal standard taken can vary according to the level of light-end components in the sample and the amount of the sample available.

9.2 Determination of backflush time

9.2.1 Initial work

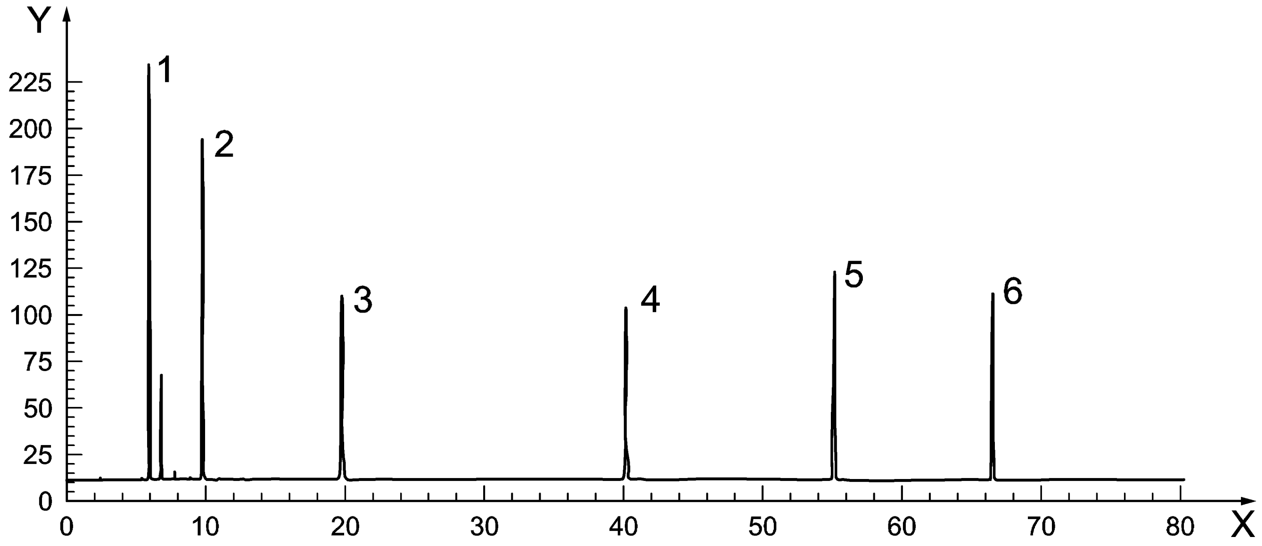
With the pre-column and analytical column in series, inject an aliquot of the pre-column switch test mixture (5.4) and determine the ratio of the alkanes.

9.2.2 Analytical column

Set the switching time to 1 min and repeat the analysis. Increase or decrease the valve time to ensure the complete recovery of the highest alkane required (e.g. nonane) and partly recovery of the next alkane (e.g. decane). (See 9.3.1 and the example chromatogram in Figure 3)

9.2.3 Accelerated analytical column

Set the switching time to 30 s and repeat the analysis. Increase or decrease the valve time to ensure the recovery of the highest alkane required (e.g. nonane) and partly recovery of the next alkane (e.g. decane). (For assistance in the identification of individual components see [1] and [2] and example chromatogram (Figure 3))



Key

1	n-Pentane	3	n-Heptane	5	n-Nonane
2	n-Hexane	4	n-Octane	6	n-Decane

Figure 3 — Example chromatogram showing elution for determining backflush time

9.3 Sample analysis

9.3.1 Initial work

Inject a suitable aliquot of the sample and internal standard onto the inlet of the pre-column which is in series with the analytical column. At the time determined above (9.2) switch the valve and back-flush the high boilers to vent.

The valve time reflects the highest carbon number required. As a general rule, if zC is required, then (z+1)C should be eluted.

9.3.2 Calculation of individual components results

Calculate each of the individual hydrocarbons up to and including n-nonane the mass fraction ω_Q using Formula (3):

$$\omega_Q = \frac{A_Q \cdot RRf_Q}{A_{\mathrm{IS}} \cdot RRf_{\mathrm{IS}}} \times \omega_{\mathrm{IS}} \tag{3}$$

Where

RRf_Q and RRf_{IS}	are the relative response factors relative to methane respectively for component Q and the internal standard IS as calculated in Clause 8,
A_Q and A_{IS}	are the areas resulting from the integration of the chromatographic detector signal within the specified retention time interval for component Q and for the internal standard IS, respectively, and
ω_{IS}	is the mass fraction (in %) of the internal standard.

These generic response factors can be transformed when using an internal standard (in this case a C_6 olefin for which the response relative to methane is 0,874) to specific factors belonging to this internal standard, by dividing all the generic factors by 0,874.

By summation of all the mass percentages per peak up to and including nonane, the mass percent of this fraction shall be calculated.

See EN 15199-3 [4] for merging of the results to give a full crude analysis.

9.3.3 Boiling point distribution of fraction up to and including nonane

Plot for all the peaks (beginning with the lowest boiling point) the cumulative mass percent versus the boiling point up to the last peak of interest, e.g. n-nonane.

10 Reporting

Report the cumulative mass percent versus boiling point results to the nearest 0,01 % (m/m), and 0,5° C respectively, up to the last peak of interest, e.g. n-nonane.

11 Precision

11.1 General

The precision of this test method was determined by statistical evaluation of the interlaboratory test results consisting of 14 laboratories (10 from Europe and 4 from the USA) analysing 8 crude oil samples in duplicate. The repeatability and reproducibility were calculated following the procedures of EN ISO 4259 [5]. The full details of the round robin are in [6].

11.2 Repeatability, *r*

The difference between two test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would in the long run, in the normal and correct operation of the test method, exceed the following value in absolute value in only one case in twenty:

$$r = 0{,}019\,82(X + 8) \tag{4}$$

Where

X is the average of the two results being compared, in % *(m/m)*.

11.3 Reproducibility, *R*

The difference between two single and independent test results, obtained by different operators working in different laboratories on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the following value in only one case in twenty:

$$R = 0{,}126\,7(X + 8) \tag{5}$$

Where

X is the average of the two results being compared, in % *(m/m)*.

12 Test report

The test report shall specify:

a) reference to this European Standard, i.e. EN 15199-4;

b) type and complete identification of the material tested;

c) result of the test (see Clause 10);

d) any deviation, by agreement or otherwise, from the standard procedures specified;

e) date of the test.

Annex A
(informative)

Analysis assistance

This annex presents examples of retention index data and chromatogram for identifying individual components. Table A.1 encompasses the total analysis, i.e. the detailed hydrocarbon analysis up to n-nonane.

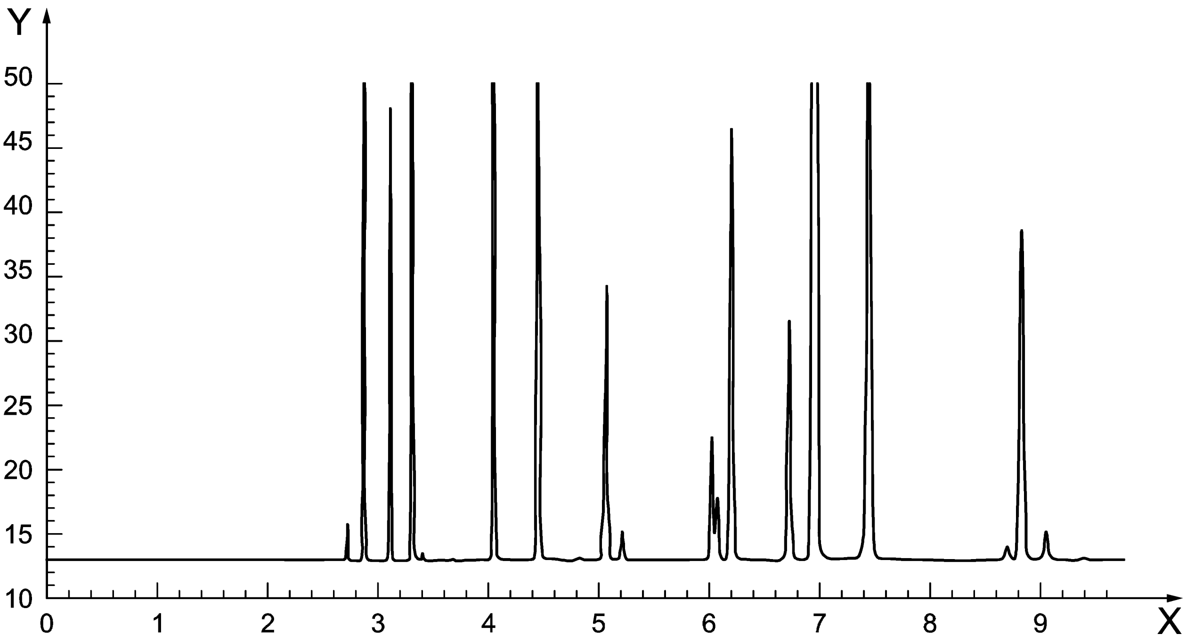
Table A.1 — Example report of an analysis

Time (min)	**Retention index**	**Component name**	**Mass %**	**Peak area** (pA.s)
2,729	200	ethane	0,018 5	2,097
2,878	300	propane	0,311 1	36,079
3,111	355,5	i-butane	0,246 4	28,907
3,312	400	n-butane	0,848 4	99,544
3,413	410,2	2,2-dimethylpropane	0,005 7	0,678
3,475	416,3	-	0,000 9	0,107
3,680	435,7	-	0,001 5	0,179
4,051	468,1	i-pentane	0,762 2	90,048
4,452	500	n-pentane	1,060 4	125,278
4,832	516	-	0,001 3	0,154
5,080	525,7	CS2	0	42,838
5,219	531	2,2-dimethylbutane	0,029 3	3,474
5,824	552,3	-	0,001 0	0,121
6,021	558,8	cyclopentane	0,143 6	17,454
6,068	560,3	2,3-dimethylbutane	0,078 6	9,328
6,198	564,5	2-methylpentane	0,546 3	64,793
6,720	580,2	3-methylpentane	0,336 1	39,861
6,945	586,6	hexene-1	0	603,992
7,333	597,2	-	0,002 4	0,282
7,439	600	n-hexane	1,015 6	120,461
7,652	604	-	0,002 7	0,317
7,930	609	-	0,002 5	0,301
8,448	617,8	-	0,002 0	0,237
8,695	621,9	2,2-dimethylpentane	0,024 1	2,872
8,824	623,9	methylcyclopentane	0,593 8	72,154
9,057	627,6	2,4-dimethylpentane	0,054 5	6,496
9,390	632,7	2,2,3-trimethylbutane	0,005 0	0,595
10,313	645,8	benzene	0,252 2	33,01
10,764	651,8	3,3-dimethylpentane	0,015 3	1,82
11,021	655,1	cyclohexane	0,832 3	101,143
11,809	664,8	2-methylhexane	0,330 5	39,357
11,940	666,4	2,3-dimethylpentane	0,127 8	15,217

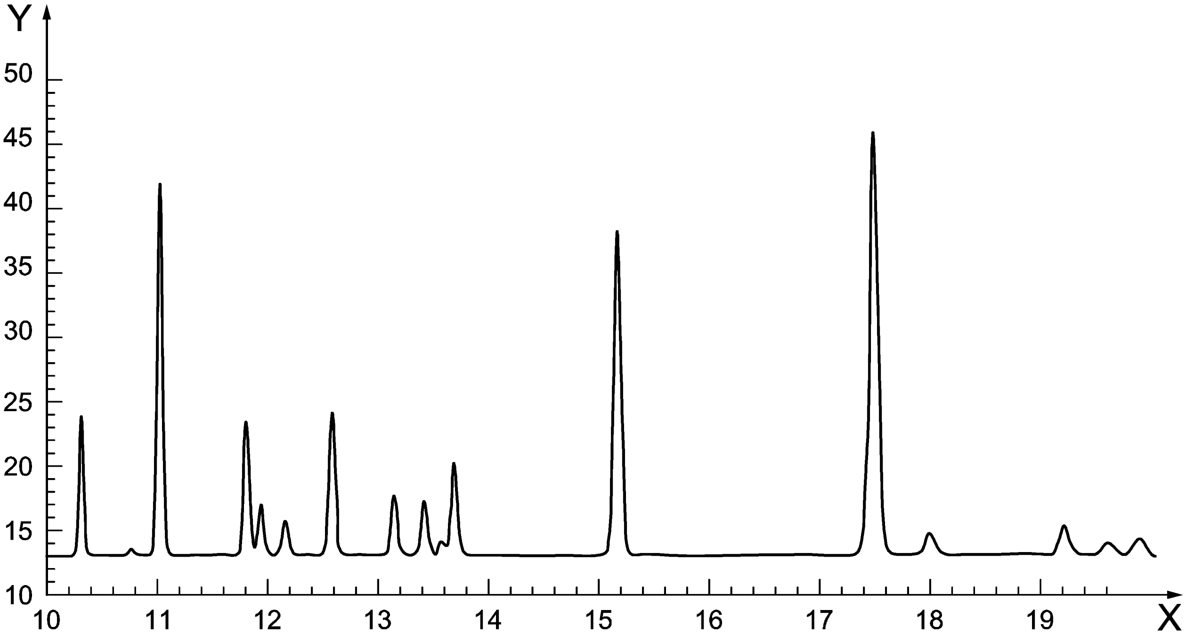
Time (min)	**Retention index**	**Component name**	**Mass %**	**Peak area** (pA.s)
12,157	668,9	1,1-dimethylcyclopentane	0,088 7	10,774
12,584	673,7	3-methylhexane	0,376 9	448,89
13,146	679,9	1c,3-dimethylcyclopentane	0,158 4	19,243
13,418	682,7	1t,3-dimethylcyclopentane	0,146 2	17,771
13,581	684,4	3-ethylpentane	0,034 1	4,056
13,689	685,6	1t,2-dimethylcyclopentane	0,263 3	31,989
15,165	699,9	n-heptane	1,005 6	119,756
17,487	717,5	methylcyclohexane+1c,2-dimethylcyclopentane	1,568 5	190,596
17,992	721	2,2-dimethylhexane+1,1,3-trimethylcyclopentane	0,094 3	11,257
19,214	729	2,2,3-trimethylpentane	0,114 2	13,632
19,614	731,6	2,5-dimethylhexane+2,2,3-trimethylpentane	0,051 9	6,189
19,889	733,3	2,4-dimethylhexane	0,069 7	8,323
20,653	737,9	1,trans-2,cis-4-Trimethylcyclopentane	0,095 6	11,62
20,942	739,6	3,3-dimethylhexane	0,017 9	2,139
21,893	745,1	1t,2c,3-trimethylcyclopentane	0,105 1	12,771
22,433	748,1	2,3,4-trimethylpentane	0,017 3	2,069
22,928	750,8	toluene+2,3,3-Trimethylpentane	0,828 4	107,225
24,481	758,9	3-methyl-3-ethylpentane	0,033 1	4,02
24,690	759,9	2,3-dimethylhexane	0,059 5	7,095
24,867	760,8	2-methyl-3-ethylpentane	0,020 3	2,421
26,103	766,8	1,1,2-trimethylcyclopentane	0,370 4	45,005
26,410	768,2	4-methylheptane+3-methyl,3-ethylpentane	0,138 3	16,508
27,544	773,4	3,4-dimethylhexane	0,320 3	38,216
27,761	774,3	3-methylheptane	0,274 1	32,704
27,973	775,3	1t,4-dimethylcyclohexane	0,187 2	22,743
29,153	780,4	1,1-dimethylcyclohexane	0,055 5	6,746
30,321	785,2	1-methyl,trans-3-ethylcyclopentane	0,048 7	5,913
30,802	787,1	1c,3-dimethylcyclohexane	0,055 3	6,725
31,110	788,3	1-methyl,trans-2-ethylcyclopentane	0,098 5	11,972
31,472	789,8	2,2,4-trimethylhexane	0,014 6	1,751
32,002	791,8	1t,2-dimethylcyclohexane	0,190 1	23,095
33,690	798,2	1c,2c,3-trimethylcyclopentane	0,110 2	13,397
34,165	799,9	n-octane	0,913 7	109,021
35,285	807,9	2,4,4-trimethylhexane	0,020 9	2,501
36,452	816,1	N1	0,009 2	1,115
37,244	821,6	N3	0,022 9	2,782
38,170	827,8	2,2-dimethylheptane	0,053 9	6,446

Time (min)	**Retention index**	**Component name**	**Mass %**	**Peak area** (pA.s)
38,601	830,7	1,1,4-trimethylcyclohexane	0,017 3	2,099
38,840	832,2	1c,2-dimethylcyclohexane	0,057 9	7,035
39,216	834,7	ethylcyclohexane + n-propylcyclopentane	0,499 1	60,645
40,046	840	N6	0,167 4	20,342
40,171	840,8	1,1,3-trimethylcyclohexane	0,169 4	20,583
40,562	843,2	2,5-dimethylheptane	0,024 3	2,9
41,124	846,7	3,3-dimethylheptane	0,087 6	10,47
41,252	847,5	N8	0,037 0	4,492
41,447	848,7	N7	0,028 0	3,402
41,725	850,4	-	0,015 6	1,869
42,311	853,9	ethylbenzene	0,196 8	25,28
42,725	856,4	I3	0,123 8	14,801
42,904	857,4	I4	0,034 1	4,082
43,414	860,4	-	0,006 1	0,731
43,733	862,3	m-xylene	0,519 0	66,672
43,911	863,3	p-xylene	0,160 7	20,648
44,394	866,1	N13	0,169 5	20,601
44,652	867,5	3,4-dimethylheptane	0,011 3	1,347
44,796	868,3	N14	0,020 7	2,512
45,015	869,6	N15	0,005 5	0,673
45,202	870,6	4-ethylheptane	0,018 9	2,26
45,697	873,4	4-methyloctane	0,147 1	17,583
45,868	874,3	2-methyloctane	0,178 1	21,297
46,173	876	1c,2t,3-trimethylcyclohexane	0,026 5	3,218
46,589	878,3	3-ethylheptane	0,038 5	4,6
46,806	879,5	3-methyloctane	0,203 6	24,349
47,022	880,6	o-xylene	0,305 6	39,26
47,265	881,9	1c,2t,4c-trimethylcyclohexane	0,015 3	1,855
47,714	884,3	I6	0,006 0	0,719
48,155	886,6	N18	0,270 0	32,809
48,467	888,3	N20	0,078 0	9,476
48,909	890,6	N21	0,013 5	1,638
49,146	891,8	i-butylcyclopentane	0,023 7	2,876
49,613	894,2	N22	0,013 5	1,642
50,061	896,5	N23/t-nonene-2	0,009 5	1,156
50,485	898,6	I9	0,026 9	3,222
50,722	899,8	n-nonane	0,951 7	113,794

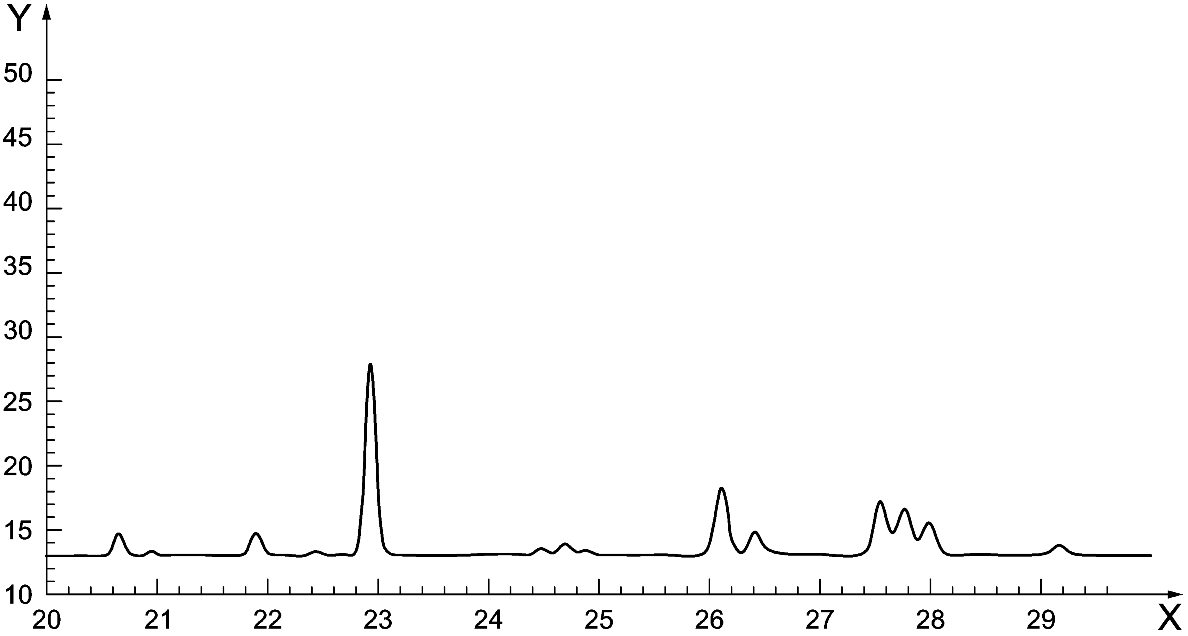
Examples of chromatograms of each part of Table A.1. are given in Figure A.1 where each time the time in min is represented on the X-axis versus the FID response (in pA) on the Y-axis



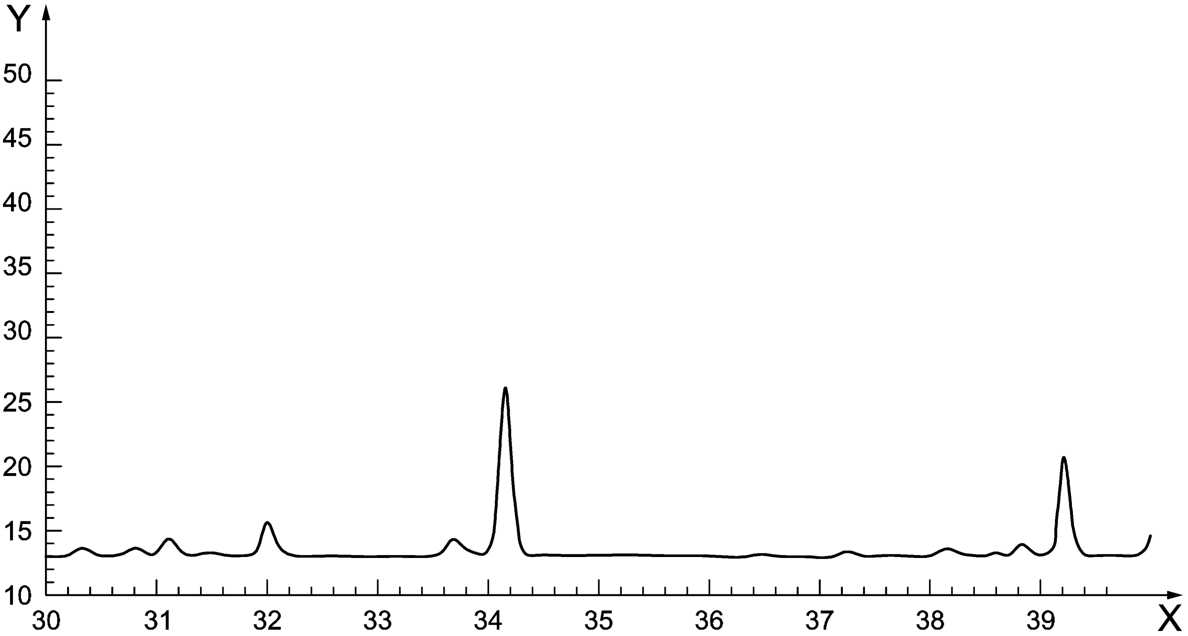
a) Section from start to 10 min



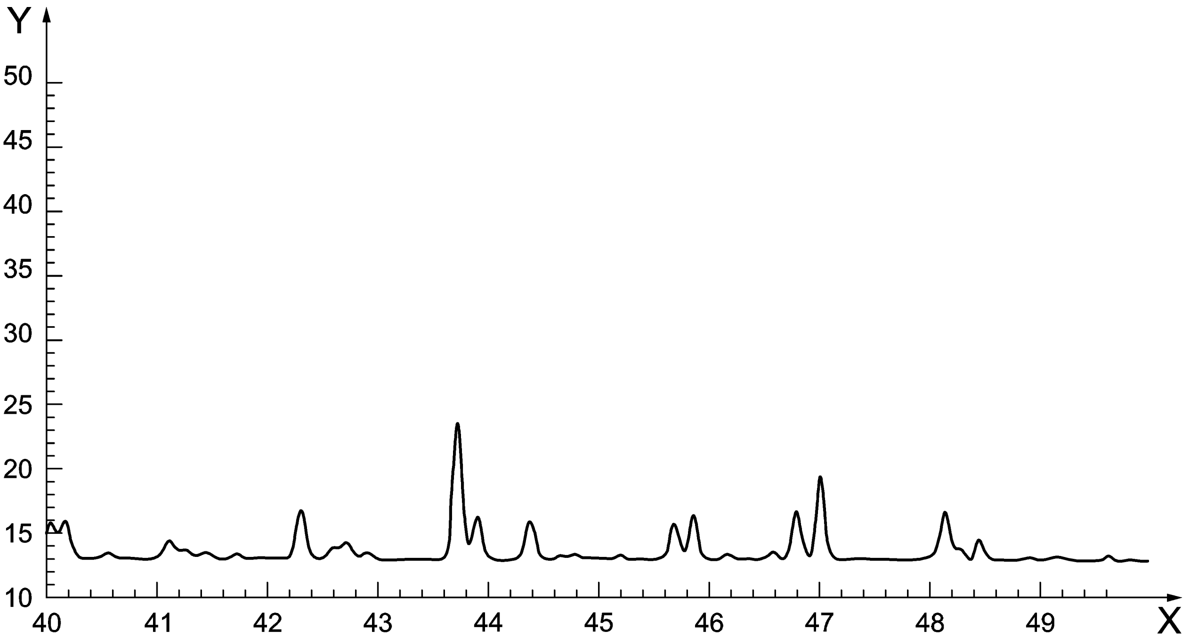
b) Section from 10 min to 20 min



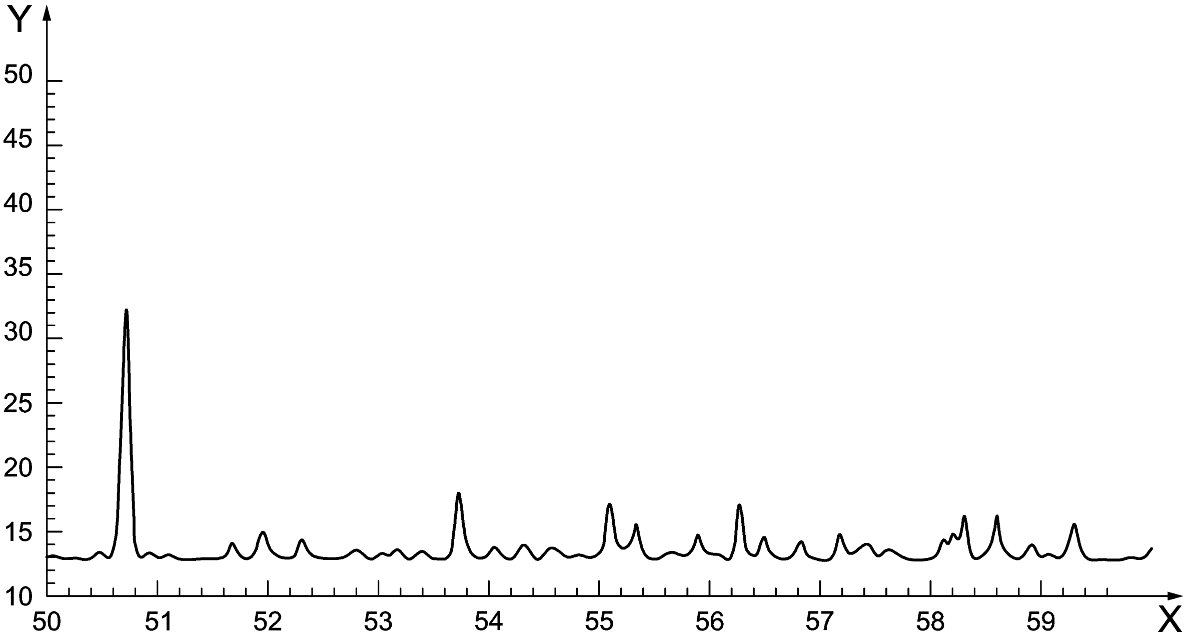
c) Section from 20 min to 30 min



d) Section from 30 min to 40 min



e) Section from 40 min to 50 min



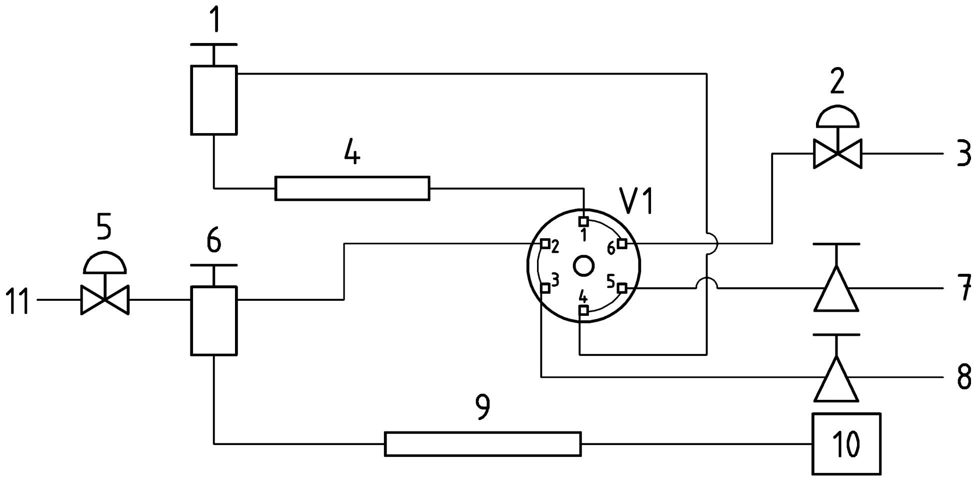
f) Section from 50 min to 60 min

Figure A.1 — Example chromatograms belonging to report data of Table A.1

Annex B
(informative)

Apparatus configuration

This annex presents three apparatus configuration schematics. Figure B.1 represents the configuration described in 6.4.1.

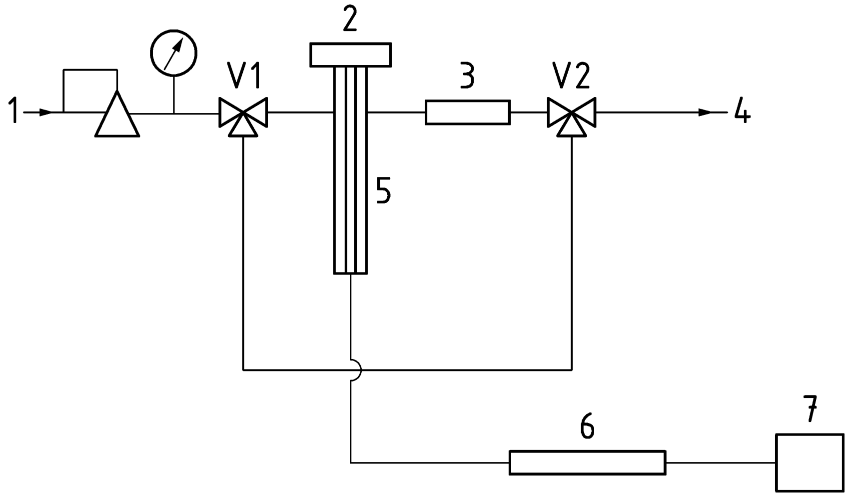


Key

1	purged packed inlet	5	backpressure regulator	9	analytical column
2	backpressure regulator	6	split/splitless inlet	10	FID
3	vent	7	carrier gas	11	vent
4	pre-column	8	carrier gas	V1	rotary switching valve

Figure B.1 — Typical configuration using a heated valve switching box

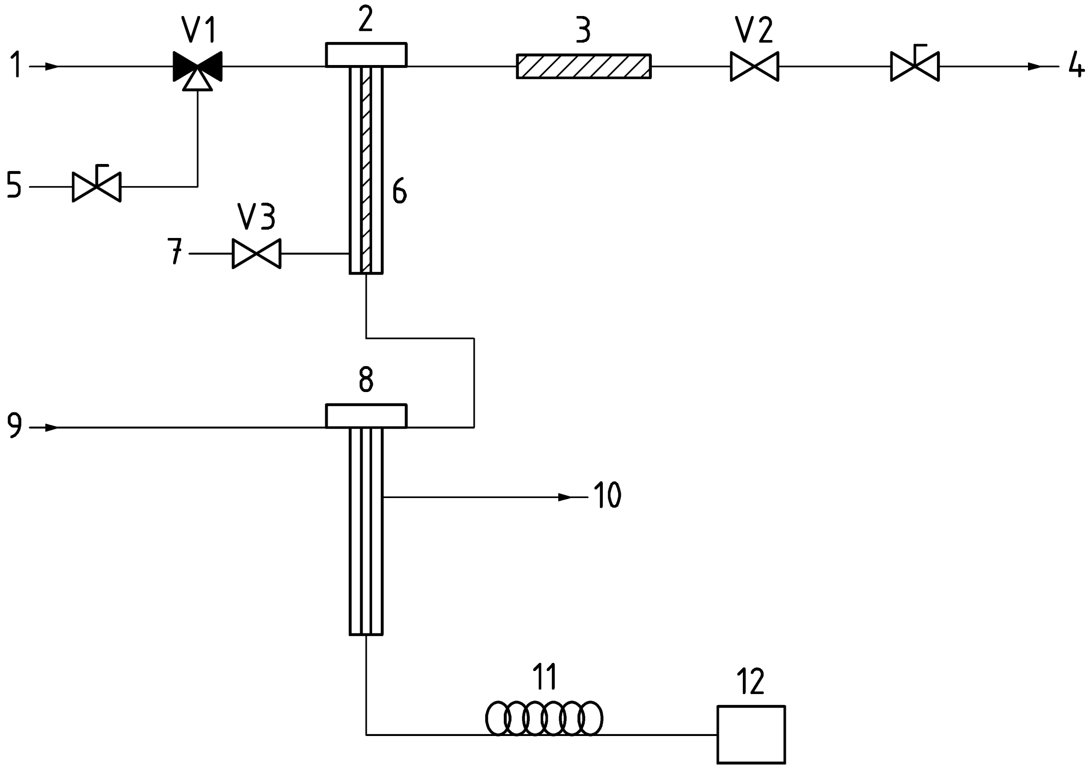
Figure B.2 and B.3 represent the configurations using a temperature programmable injection port as discussed under 6.4.2.



Key

1	carrier gas	3	filter	5	liner	7	FID
2	injection port	4	vent	6	column	V1, V2	3-way valves

Figure B.2 — Typical configuration with direct connection to the capillary column



Key

1	carrier gas	5	vent	9	carrier gas
2	temperature programmable inlet	6	prefractionator liner	10	split vent
3	filter	7	cooling air	11	column
4	backflush vent	8	split/splitless inlet	12	FID
V1	3-way valve	V2, V3	open/close valve		

Figure B.3 — Typical configuration with a connection via a splitter to the capillary column

Bibliography

[1] IP 601, *Determination of light hydrocarbons in stabilised crude oils - Gas chromatography method*

[2] ASTM D7900-13, *Determination of Light Hydrocarbons in Stabilized Crude Oils by Gas Chromatography*

[3] IP 481, *Determination of air saturated vapour pressure (ASVP) of crude oil*

[4] EN 15199-3, *Petroleum products — Determination of boiling range distribution by gas chromatography method — Part 3: Crude oil*

[5] EN ISO 4259, *Petroleum products — Determination and application of precision data in relation to methods of test (ISO 4259)*

[6] Research Report IP PM DL, Energy Institute, London, UK

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